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ABSTRACT

The Federal Aviation Administration (FAA) Academy has been using a systems approach as part of its training program since 1969. This booklet describes the general characteristics of an instructional system and explains the steps the FAA goes through in implementing the approach. These steps are: 1) recognize a need for training, 2) specify the training required, 3) develop a detailed training plan, 4) consider alternatives, 5) coordination and approval, 6) develop specific instructional objectives, 7) develop criterion test, 8) develop learning strategies, 9) formulate lesson plans and guides, and 10) tryout and revise. In the classroom, student comprehension of the material is monitored as the student answers the instructor's questions on a student response panel. Other feedback is obtained through daily quizzes, problems, and tests. This feedback is the basis for remedial instruction and curriculum revision. (JK)

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AN
INSTRUCTIONAL SYSTEMS APPROACH
OR
FAA STUDENT CENTERED TRAINING

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FOREWORD

The Federal Aviation Administration Academy is engaged in the training of employees in many technical fields. These employees are responsible for the efficient operation, maintenance, and management of FAA activities throughout the world. Our goal at the Academy is to train these people as efficiently and effectively as possible.

This article describes a training approach which we think will prove effective in accomplishing our goal.



C. D. Rea
Superintendent
FAA Academy

8 August 1969

AN INSTRUCTIONAL SYSTEMS APPROACH

In late 1967 the Federal Aviation Administration Academy embarked upon a program to improve training effectiveness by making training more job oriented and student centered. Staff personnel investigated various instructional system approaches including that used by Trans-World Airlines. Staff members attended a Programmed Instruction Workshop at the University of Michigan to gain additional experience in training approaches. In March 1968 the first class of Academy instructors completed a one-week course designated Student Centered Training Workshop. Based upon this initial training, some course developers began up-dating training courses in accordance with the instructional systems concept. By the end of 1968 additional instructors and course developers had been trained in the systems concept and several technical courses had been revised to include the systems approach. Also, two staff members received additional out-of-agency professional training at the University of Rochester. This additional experience was used in the development of specialized instructor and course developer training programs for the Academy. By early 1969 several new training courses had been developed and were being presented in accordance with the systems concept.

The initial efforts by the FAA Academy resulted in the instructional systems concept being designated "Student Centered Training" or SCT. It is recognized that SCT, as used at the Academy, is referred to in professional education and training circles as an instructional systems approach. Therefore, in the remainder of this article we will use the more common designation - instructional systems approach.

CHARACTERISTICS OF AN INSTRUCTIONAL SYSTEM

The instructional systems approach is a widely accepted and proven training system. It combines the experience gained by research in programmed instruction (self-teaching) with the most effective group-teaching techniques. An instructional system is tailored to the specific needs of employees who will perform a particular job, task, or learning exercise. The effective instructional system is multi-media - it makes the most effective use of slides, film, mock-ups, simulators, individualized self-study materials, worksheets, work exercises, and individual student guidance.

Comparison with engineering approach. The instructional systems approach borrows the approach used by engineers in designing a product such as a new car, a ballistic missile system, the super-sonic transport (SST), or the Apollo moon exploration system. In either case, the broad goals must be

identified and approved. A feasibility study must be performed to determine: what are the possible solutions; how urgent is the need; how long will it take to satisfy the need; how much will it cost; and how costs versus benefits compare.

Detailed Task Analysis. Based upon the outcome of the feasibility study, the next step in the instructional systems approach includes a detailed analysis of the tasks to be performed. This analysis makes it possible to specify clear objectives and desired standards of trainee performance. Also, we are now in a position to establish criteria or test which the product (or trainee) must pass in order to be acceptable. We need this information whether we are designing an automated air traffic control system, a space exploration vehicle, or a training course. This data becomes the basis for all of the detailed design, development, sequencing, assembly, and testing which follows. This careful planning is essential to ensure effectiveness and efficiency in both the developmental process and the final product.

Job-Oriented Student-Centered. An instructional system is often described as job-oriented and student-centered. This means that the training course is designed and taught in a manner which will ensure that a given type of employee will be able to satisfactorily perform specific job tasks upon graduation. Only knowledges and skills required on the job

are emphasized. Training continually relates these knowledges and skills to the operational situation. The student will know why he is required to learn each bit of information and therefore should be more eager to learn. When training is student-centered, the trainee is actively involved in each step of instruction. He is an active learner. He may be answering questions, completing a work exercise, solving problems, making decisions or performing a task which requires physical and/or intellectual skill. The systems approach makes learning a two-way communication process. The student interacts with the instructor, other students, instructional aids, equipment etc.

Student and Instructor Feed-back. In order for learning to be most effective, the learner must know how he is doing. This feed-back process is built into the instructional system so the learner consistently knows when he is performing correctly. Also, the instructor knows how each student is doing and this feed-back guides him in providing appropriate remedial instruction.

The feed-back characteristic of the systems approach ensures that students learn critical information and procedures. In fact, the system is tested, revised, and improved until it consistently produces quality graduates. Also, the feed-back process is used to ensure that training remains technically correct and current.

HOW FAA USES THE SYSTEMS APPROACH

The instructional systems approach has been implemented to varying degrees at the FAA Academy. Therefore, we will describe only a fully operational, proven system - a course that is effectively and efficiently meeting specified training needs.

Training Need. A training course at the FAA Academy comes into being as a result of an analysis of an operational or management problem. If the analysis indicates that a specific training need exists, a training proposal is prepared by the operational activity and submitted to the FAA Academy through the training office.

Training Proposal and Training Plan. The training proposal tells the Academy what type of employees are to be trained and what they must be able to do. Based upon the information contained in the training proposal, the Academy and the operating element perform a job/task analysis. The purpose of the job/task analysis is to determine the specific knowledges and skills which are required in order for the employee to successfully perform the job. Decisions are made as to what skills and knowledges trainees are assumed to have, what level of training is required, how long it will take to accomplish, how much the training will cost, and when the first class can be conducted. This information is submitted in the form of a training plan and is the Academy's response to the user's training proposal.

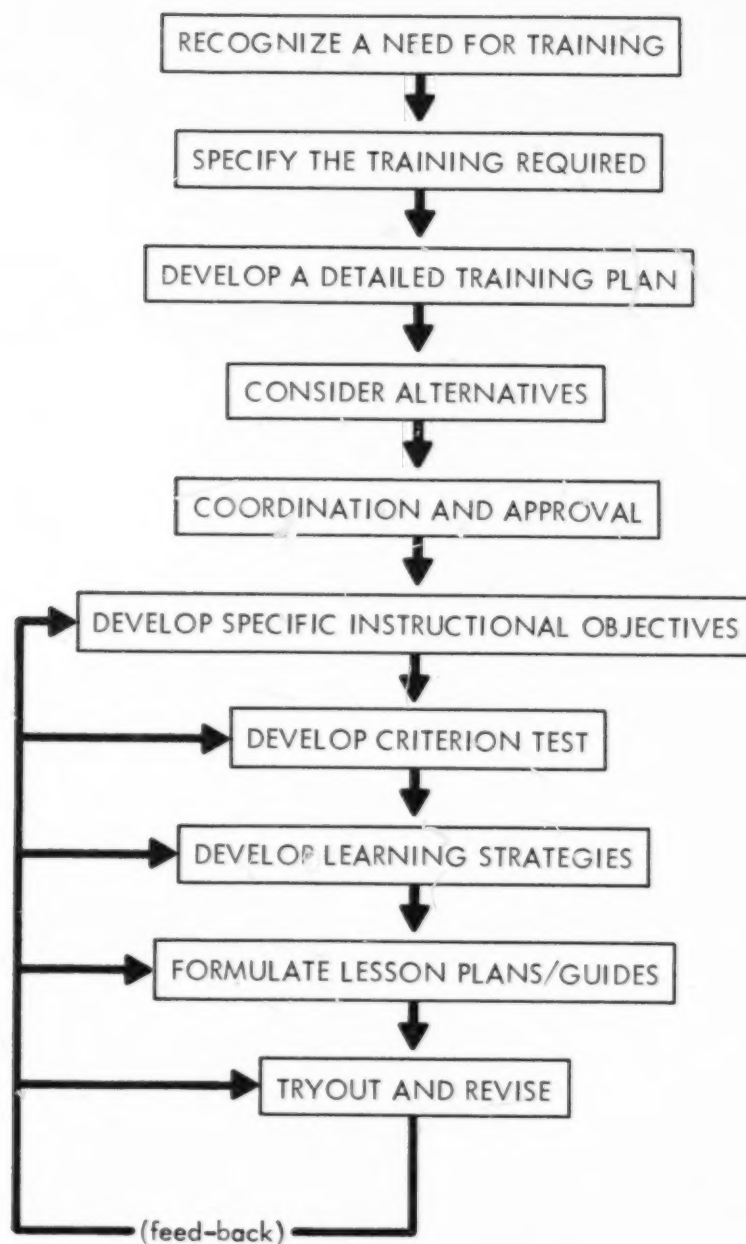
Steps in Course Development. Upon approval of the training plan, the Academy develops a course in accordance with the procedures and specifications outlined therein. Course development activities under the systems approach include:

1. Developing instructional objectives and sub-objectives.
2. Arranging objectives into clusters or units.
3. Organizing clusters (units) to form a logical learning sequence or course structure.
4. Developing a criterion test (Job performance objective test) for each objective.
5. Validating both objectives and criterion tests.
6. Developing learning sequences and strategies - specify media, aids, methods, training materials and exercises, laboratory projects, response items, etc.
7. Developing end-of-phase and/or end of course criterion tests.
8. Developing lesson plans and/or instructor guides.
9. Tryout, revision, and validation of the instructional system.

Technical courses are completely developed by a "course development unit" which is made up of the better qualified instructors. These "master instructors" develop lesson plans, audio/visual aids, work exercises, laboratory exercises, and evaluation devices. Also, they try-out (validate) and revise each lesson. This hand-off to the classroom instructor ensures that each lesson is taught the way it was planned. NOTE: Table 1, Developing an Instructional System, shows the activities involved in developing an instructional system.

TABLE I

DEVELOPING AN INSTRUCTIONAL SYSTEM



Classroom Presentation. In the classroom the instructor uses the approved lesson plan and personal notes which he developed while preparing to teach the lesson. The classroom includes a custom-built lectern from which the instructor can control lights, a back-screen movie projector, a back-screen 35mm slide projector and an over-head projector. In addition, the lectern includes a student response monitor system. The response monitor system provides each student with a small panel on which is installed three selector buttons, a "select" light, a "right" indicator light and a "wrong" indicator light. Typically, the instructor teaches bits of essential information in accordance with the approved lesson plan. Before presenting additional new information, the instructor asks questions (stimulus) which cause the student to use what he has learned. The questions, called response items, are presented by using the 35mm slide projector or the overhead projector. Each student responds by selecting the answer he believes to be correct and pushing a button (A, B, or C) on the student response panel. The student immediately receives confirmation as to whether his selection is right or wrong. In addition, his selection appears on the instructor's response monitor panel opposite the student's name. Thus, the instructor continuously monitors the student's success as a learner, and

his own effectiveness as an instructor, in accomplishing the lesson objectives. Remedial instruction is based on the student responses and is accomplished immediately to ensure that each student understands critical information prior to the presentation of new and/or more difficult material.

Review of Instructional Systems Approach. At this point let us review the instructional systems approach. It is designed to train students in the knowledges and skills required to perform a given job. It requires feed-back information so that corrective action can be taken and learning can be assured. The instructor is provided with a proven systematic means of teaching a lesson in a logical sequence. Both he and the student are continuously aware of the progress they are making toward meeting clearly defined lesson objectives.

Advantages of Instructional Systems Approach. Although the sophisticated lectern, back-screen projection and the student response monitor were very useful aids in implementing the instructional system approach at the FAA Academy, they only support the systems concept. The instructor primarily uses these aids to prepare the student so he can perform more job-like training exercises. The trainee is active in all phases of instruction: he communicates verbally (discusses) with other students and the instructor; he analyzes problems to determine corrective action; he solves problems and completes job-like exercises and assignments. All of these activities must contribute to accomplishment of the instructional objectives.

In many FAA technical courses, a laboratory or performance workshop permits the trainee to develop proficiency in skills and techniques similar to the actual job. In the laboratory, the trainee is guided through carefully planned skill-developing activities. The instructor maintains a careful surveillance and provides the trainee with assistance, remedial instruction, and encouragement. The instructor and student continue to have the same goals - effectively developing knowledges and skills which will provide FAA with a proficient employee.

EVALUATING TRAINING EFFECTIVENESS

An instructional system has been defined as "a dynamic process which continuously evaluates the efficiency and effectiveness of instruction based on analysis of criterion test results and graduate performance."

What is the Purpose of Tests? Testing and evaluation must be an integral part of the instructional system. The instructor uses response items, daily quizzes, problems, and tests to determine if the student has learned the essential knowledges and skills specified by the instructional objectives. The results from this type of testing effectively serve as feedback to indicate the need for remedial instruction and curricula improvement.

For record and analysis purposes, phase tests are designed and administered at the end of appropriate blocks of instruction. These tests are sometimes called criterion tests since they are based on the criteria established by the instructional objectives. Such a phase test may be used to indicate how well the student has learned the knowledges and skills specified. Since the phase or criterion test is designed to determine if the objectives have been achieved, highly effective instruction should result in near-perfect student scores. Test scores from a valid criterion test are analyzed to determine:

- the strength and weakness of individual students/classes on each training objective.
- the need for remedial instruction.
- the areas in which achievement is less than adequate so that course materials and/or instruction can be improved.
- the effectiveness of different instructional approaches and techniques.

Essentials of a testing program. In order to assure that tests accomplish the tasks indicated above, these procedures are followed:

- instructional objectives are clearly described and the level of instruction is defined.
- each test item requires the student to perform as prescribed by the instructional objectives.
- proven test construction practices are used.

- the total testing program includes a comprehensive coverage of the instructional objectives.
- each alternate test includes a representative coverage of the instructional objectives for the area tested.
- test and item analysis is accomplished and displayed in usable form.
- feed-back from tests is used to improve instruction and tests.

Management use of test results. Management uses the testing program as part of a training quality control system. The instructional staff seeks to produce the high quality student performance desired by the user of the graduates. Management strives to assure that the desired high quality of training is obtained with the least possible expenditure of resources. Although the testing program is just one of the processes used to monitor the training program, a valid testing program provides data which makes intelligent management decisions possible.

SUMMARY

An instructional systems approach has only one prime objective - use proven educational technology to produce more effective training in less time and at less cost than is often possible by other training methods. The systems approach must incorporate feedback so that adjustments can be

made if changes occur in the job-required knowledges and/or skills. An instructional systems approach can produce consistent and predictable learner knowledges and skills. But, training must be designed and presented so that each participant receives the same type and quality of learning experiences. Finally, the criterion test must be used to verify that instructional objectives have been achieved.

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Comments and/or questions will be appreciated.